IN THE CLAIMS:

Please add Claim 41 as follows:

1. (Previously Presented) A projection apparatus for projecting a pattern formed on a mask held by a mask stage onto a substrate, said projection apparatus comprising:

a charged particle beam source which emits a charged particle beam;

an irradiation system which has a shaping system for shaping the charged particle beam to have an arcuate cross-section and which irradiates the mask with the arcuate cross-sectional charged particle beam;

a projection optical system which projects the pattern onto the substrate, said projection optical system including a first unit having first and second magnetic lenses; and

a controller arranged to move a principal plane of said first unit in a direction of an optical axis of said projection optical system so that an image distortion of said projection optical system is corrected,

wherein said controller changes an on-axis distribution of a magnetic field generated by said first unit to move the principal plane of said first unit by changing a ratio of currents to be respectively supplied to said first and second magnetic lenses.

2. (Cancelled)

3. (Previously Presented) The apparatus according to claim 1, wherein said projection optical system further includes a second unit having third and fourth magnetic lenses, and

wherein said controller is further arranged to change a ratio of currents respectively supplied to said third and fourth magnetic lenses to move a principal plane of said second unit so as not to change an image position and magnification of said projection optical system when moving the principal plane of said first unit.

4. (Previously Presented) The apparatus according to claim 1, wherein said projection apparatus further comprises an acquisition system which acquires image information indicating a feature of an image projected onto a substrate stage for supporting the substrate by measurement, and

wherein said controller is further arranged to change the ratio of the currents to be respectively supplied to said first and second magnetic lenses so as to correct an image distortion of said projection optical system on the basis of the image information.

5. (Previously Presented) The apparatus according to claim 4, wherein said acquisition system acquires image information containing information indicating a radius of an image formed on the substrate stage with the arcuate cross-sectional charged particle beam emerging from said shaping system.

6. (Previously Presented) The apparatus according to claim 5, wherein said controller is further arranged to change the ratio of the currents to be respectively

supplied to said first and second magnetic lenses, so that the measured radius coincides with a theoretical radius obtained when said projection optical system has no aberration.

7. (Previously Presented) The apparatus according to claim 4, wherein said acquisition system acquires image information containing information indicating an image height of an image formed on the substrate stage with the arcuate cross-sectional charged particle beam that has passed through said shaping system.

8. (Previously Presented) The apparatus according to claim 7, wherein said controller is further arranged to change the ratio of the currents to be respectively supplied to said first and second magnetic lenses, so that the actually measured image height coincides with a theoretical image height obtained when said projection optical system has no aberration.

9. (Previously Presented) The apparatus according to claim 4, wherein said acquisition system comprises (a) an image distortion measurement mask having a transmitting system that passes therethrough a predetermined portion of the arcuate cross-sectional charged particle beam, said mask being held by said mask stage during measurement, and (b) a measurement unit for measuring coordinates of a position where the charged particle beam that has passed through said transmitting system becomes incident on the substrate stage, and

wherein said acquisition system calculates image information indicating a feature of an image projected onto the substrate stage on the basis of the measured coordinates.

10. (Previously Presented) The apparatus according to claim 9, wherein said image distortion measurement mask has a plurality of transmitting systems arranged arcuatedly, and

wherein said measurement unit measures coordinates of respective positions where charged particle beams that have passed through said transmitting systems become incident on the substrate stage.

11. (Previously Presented) The apparatus according to claim 10, wherein said acquisition system calculates a radius of an image projected onto the substrate stage on the basis of a plurality of measured coordinates, and

wherein said controller is further arranged to change the ratio of the currents to be respectively supplied to said first and second magnetic lenses, so that a radius obtained by measurement coincides with a theoretical radius obtained when said projection optical system has no aberration.

12. (Previously Presented) The apparatus according to claim 9, wherein said acquisition system further comprises a substrate having a mark, the substrate being placed on the substrate stage during measurement, and

wherein said measurement unit detects backscatter electrons from the substrate, thereby measuring coordinates of a position where the charged particle beam that has passed through said transmitting system becomes incident on the substrate stage.

13. (Previously Presented) The apparatus according to claim 12, wherein measurement of the coordinates of the incident position is performed while moving the substrate stage such that the mark moves across the position where the charged particle beam that has passed through said transmitting system becomes incident on the substrate stage.

14. (Previously Presented) The apparatus according to claim 13, wherein the mark is a crisscross mark made of a heavy metal.

15. (Previously Presented) A control method for a projection apparatus having a mask stage for holding a mask, a charged particle beam source which emits a charged particle beam, an irradiation system which has a shaping system for shaping the charged particle beam to have an arcuate cross-section and which irradiates the mask with the arcuate cross-sectional charged particle beam, and a projection optical system which projects the pattern onto a substrate, the projection optical system including a first unit having first and second magnetic lenses, said method comprising:

an acquisition step of acquiring correction information necessary for correcting aberrations of the projection optical system; and

a control step of moving a principal plane of the first unit so that an image distortion of the projection optical system is corrected,

wherein said control step comprises changing an on-axis distribution of a magnetic field generated by said first unit on the basis of the correction information to move the principal plane of said first unit by changing a ratio of currents to be respectively supplied to said first and second magnetic lenses.

16. (Cancelled)

17. (Previously Presented) The method according to claim 15, wherein the projection optical system further includes a second unit having third and fourth magnetic lenses, and

wherein said control step comprises changing a ratio of currents respectively supplied to the third and fourth magnetic lenses to move a principal plane of the second unit so as not to change an image position and magnification of the projection optical system when moving the principal plane of the first unit.

18. (Previously Presented) The method according to claim 15, wherein said acquisition step includes the measurement step of acquiring by measurement image information indicating a feature of an image projected onto a substrate stage for supporting the substrate as the correction information, and

wherein said control step comprises correcting an image distortion of the projection optical system on the basis of the image information.

19. (Previously Presented) The method according to claim 18, wherein said acquisition step comprises the step of acquiring image information containing information indicating a radius of an image formed on the substrate stage with the arcuate cross-sectional charged particle beam emerging from the shaping system.

20. (Previously Presented) The method according to claim 19, wherein said control step comprises controlling the ratio of the currents to be respectively supplied to the first and second magnetic lenses, so that the measured radius coincides with a theoretical radius obtained when the projection optical system has no aberration.

21. (Previously Presented) The method according to claim 18, wherein said acquisition step comprises the step of acquiring image information containing information indicating an image height of an image formed on the substrate stage with the arcuate cross-sectional charged particle beam that has passed through the shaping system.

22. (Previously Presented) The method according to claim 21, wherein said control step comprises changing the ratio of the currents to be respectively supplied to the first and second magnetic lenses, so that the actually measured image height coincides with a theoretical image height obtained when the projection optical system has no aberration.

23. (Previously Presented) The method according to claim 15, wherein said acquisition step comprises (a) a preparation step of causing the mask stage to hold an

image distortion measurement mask having a transmitting system that passes therethrough a predetermined portion of the arcuate cross-sectional charged particle beam, (b) a measurement step of measuring coordinates of a position where the charged particle beam that has passed through the transmitting system becomes incident on a substrate stage for supporting the substrate, and (c) a calculation step of calculating, as correction information necessary for correcting an image distortion of the projection optical system, image information indicating a feature of an image projected onto the substrate stage on the basis of the measured coordinates, and

wherein said control step comprises changing the ratio of the currents to be respectively supplied to the first and second magnetic lenses to move a principal plane of the first unit so as to correct an image distortion of the projection optical system on the basis of the correction information.

24. (Previously Presented) The method according to claim 23, wherein the image distortion measurement mask has a plurality of transmitting systems arranged arcuatedly, and

wherein the measurement step comprises measuring coordinates of respective positions where charged particle beams that have passed through the transmitting systems become incident on the substrate stage.

25. (Previously Presented) The method according to claim 24, wherein said calculation step in the acquisition step comprises calculating a radius of an image projected onto the substrate stage on the basis of a plurality of measured coordinates, and

wherein said control step comprises changing the ratio of the currents to be respectively supplied to the first and second magnetic lenses, so that a radius obtained by measurement coincides with a theoretical radius obtained when the projection optical system has no aberration.

26. (Previously Presented) The method according to claim 23, wherein said acquisition step further comprises the step of placing a substrate having a mark on the substrate stage before measurement, and

wherein said measurement step in said acquisition step comprises detecting backscatter electrons from the substrate, thereby measuring coordinates of a position where the charged particle beam that has passed through the transmitting system becomes incident on the substrate stage.

27. (Previously Presented) The method according to claim 26, wherein said measurement step comprises measuring the coordinates of the incident position while moving the substrate stage such that the mark moves across the position where the charged particle beam that has passed through the transmitting system becomes incident on the sample stage.

28. (Previously Presented) The method according to claim 27, wherein the mark is a crisscross mark made of a heavy metal.

29. (Previously Presented) A method of manufacturing a device, comprising the steps of:

fixing a mask on the mask stage of the projection apparatus according to claim 1;

placing a substrate on a substrate stage of the projection apparatus; and

transferring a pattern formed on the mask onto the substrate.

30. (Previously Presented) The apparatus according to claim 1, wherein said controller is further arranged to change the ratio of the currents respectively supplied to said first and second magnetic lenses so as to correct 3rd- and 5th-order image distortions of said projection optical system.

31. (Previously Presented) The apparatus according to claim 1, wherein said controller is further arranged to change the ratio of the currents respectively supplied to said first and second magnetic lenses under a condition that a sum of the currents respectively supplied to said first and second magnetic lenses is substantially constant.

32. (Previously Presented) The apparatus according to claim 3, wherein said controller is further arranged to change the ratio of the currents respectively supplied to said third and fourth magnetic lenses under a condition that a sum of the currents respectively supplied to said third and fourth magnetic lenses is substantially constant.

33. (Previously Presented) A projection apparatus for projecting a pattern formed on a mask onto a substrate, said projection apparatus comprising:

an irradiation system which irradiates the mask with a charged particle beam emerging from a charged particle beam source;

a projection optical system which has a magnetic lens and which projects the pattern onto the substrate; and

a controller arranged to move a principal plane of said magnetic lens in a direction of an axis of said projection optical system so as to adjust an image distortion of said projection optical system,

wherein said controller changes an on-axis distribution of a magnetic field generated by said magnetic lens to move the principal plane of said magnetic lens by controlling a current to be supplied to said magnetic lens.

34. (Previously Presented) The apparatus according to claim 33, wherein said controller is further arranged to adjust 3rd- and 5th-order image distortions of said projection optical system.

35. (Previously Presented) A projection apparatus for projecting a pattern formed on a mask onto a substrate, said projection apparatus comprising:

an irradiation system which irradiates the mask with a charged particle beam emerging from a charged particle beam source;

a projection optical system which projects the pattern onto the substrate, said projection optical system including (a) a first unit having first and second magnetic lenses and

(b) a second unit having third and fourth magnetic lenses; and

a controller arranged to change a ratio of currents to be respectively supplied to said first and second magnetic lenses to move a first principal plane of said first unit in a direction of an optical axis of said projection optical system and to change a ratio of currents to be respectively supplied to said third and fourth magnetic lenses to move a second principal plane of said second unit in the direction of the optical axis so as not to change a magnification of said projection optical system while correcting an image distortion of said projection optical system,

wherein a moving amount of the second principal plane is equal to a value obtained by multiplying a moving amount of the first principal plane by a magnification of said projection optical system, and a moving direction of the first principal plane is the opposite direction to that of the second principal plane.

36. (Previously Presented) The apparatus according to claim 35, wherein said controller is further arranged to change the ratio of the currents to be respectively supplied to said first and second magnetic lenses and the ratio of currents to be respectively supplied to said third and fourth magnetic lenses under a condition that a sum of the currents respectively supplied to said first and second magnetic lenses is substantially constant and a sum of the currents respectively supplied to said third and fourth magnetic lenses is substantially constant.

37. (Previously Presented) The apparatus according to claim 35, wherein said controller is further arranged to change the ratio of the currents to be respectively supplied to said first and second magnetic lenses and the ratio of currents to be respectively supplied to said third and fourth magnetic lenses so as to adjust an image distortion of said projection optical system.

38. (Previously Presented) The apparatus according to claim 35, wherein said controller is further arranged to change the ratio of the currents to be respectively supplied to said first and second magnetic lenses and the ratio of currents to be respectively supplied to said third and fourth magnetic lenses so as to adjust 3rd- and 5th-order image distortions of said projection optical system.

39. (Previously Presented) A method of manufacturing a device, said method comprising the steps of:

transferring a circuit pattern onto a substrate using the projection apparatus of claim 33; and

developing the resultant substrate.

40. (Previously Presented) A method of manufacturing a device, said method comprising the steps of:

transferring a circuit pattern onto a substrate using the projection apparatus of claim 35; and

developing the resultant substrate.

41. (New) A projection apparatus for projecting a pattern formed on a mask onto a substrate, said projection apparatus comprising:

an irradiation system which irradiates the mask with a charged particle beam emerging from a charged particle beam source;

a projection optical system which has a magnetic lens and which projects the pattern onto the substrate; and

a controller arranged to move a principal plane of said magnetic lens in a direction of an axis of said projection optical system so as to adjust an image distortion of said projection optical system, the image distortion being distortion caused by an error of a projected image position in a direction perpendicular to the optical axis of said projection optical system,

wherein said controller changes an on-axis distribution of a magnetic field generated by said magnetic lens to move the principal plane of said magnetic lens by controlling a current to be supplied to said magnetic lens.